

**TRENHOLM STATE TECHNICAL COLLEGE'S 018864
HIGH SCHOOL SCIENCE ENRICHMENT PROGRAM:
A 1995-'96 FINAL EVALUATION REPORT**

**Submitted to:
Elizabeth Ross
Program Director**

**Prepared by:
Benson Penick & Associates, Inc.
October 1996**

EXECUTIVE SUMMARY

Since the summer of 1994, Trenholm State (AL) Technical College has operated the NASA-supported High School Science Enrichment Program (HSSEP).

HSSEP provides math/science, computer science and communications enrichment for minority 9th-12th graders who reside in Montgomery or Lowndes County (AL). HSSEP's proposal called for the Program to serve 40-50 students with high academic potential and an interest in mathematics and science in each of its three sessions (i.e., a seven-week Summer Science Training Camp and two 10-week academic-year Saturday Academies).

The purpose of this follow-up evaluation report is four-fold:

- (1) to determine whether HSSEP has been able to replicate and improve upon its initial implementation success;
- (2) to determine whether closer collaboration with local school districts improved participants' classroom performance in math/science;
- (3) to determine whether there are any systematic outcome differences for HSSEP students with diverse demographic characteristics, educational backgrounds or Program participation patterns; and
- (4) to determine whether the grantee has taken any steps to increase the program's (positive) impact and provide resources for continuing operations once NASA funding is discontinued.

Among its findings were evidence that HSSEP's approach to mathematics applications; integrated "hands-on" science; computer programming; communications; and field experiences led to:

- enrollment goals being exceeded without budget increases;
- continued success in attracting and retaining students at earlier points in the educational pipeline;
- 97 percent average attendance rates;
- Three-fourths of all participants strongly agreeing or agreeing that the Program was effectively implemented;
- Strong agreement from at least 70 percent of student respondents that all (non-communications) components of HSSEP were instrumental in increasing their math/science interest and learning;

- All student learning objectives other than PASCAL programming and software mastery were accomplished by most or all of the HSSEP students;
- Significant increases in students' pre-test/post-test ACT math scores and substantial increases in science scores;
- Significantly higher math/science GPAs for students who persist in the Program (versus non-persisters); and
- in a county with only 6.5 percent of African-Americans completing special math/science academic programs and only 9 percent planning to pursue technical careers, 90 percent of all 1995-'96 HSSEP seniors enrolled in college with 78 percent of them majoring in engineering or science.

Efforts are underway to expand HSSEP's outreach to Lowndes County students who are currently not experiencing the same positive outcomes as their Montgomery counterparts. Trenholm College is also seeking resources to continue the program once NASA funding is no longer available.

Based on findings and discussion presented earlier in this document, the Evaluator suggests that HSSEP:

- (1) **Make improving the outcomes of rural students a priority and ensure that there is continuous monitoring and evaluation to determine whether other participant groups may also require special interventions, in order to fully benefit from HSSEP;**
- (2) **Actively seek NASA technical assistance in addressing the Program's technology equipment and institutional development needs;**
- (3) **Use emerging technology to expand Program impact and identify sources of continuation funding, as well as supplement existing intervention strategies. As noted in the January 1996 Report, HSSEP may wish to consider adding Internet assignments as a career exploration tool, a resource in its SAT preparation process, and a proactive approach to retaining juniors and seniors;**
- (4) **Provide adequate resources for future evaluations to address emerging issues and enable Trenholm to disseminate information about HSSEP's success with non-traditional (e.g., rural, marginally prepared) populations; and**
- (6) **Take steps to improve the integration of technical and communications content and learning objectives.**

PROGRAM RATIONALE AND HISTORY

Since the summer of 1994, Trenholm State (AL) Technical College has received support from the National Aeronautics and Space Administration (NASA) to operate its High School Science Enrichment Program (HSSEP). HSSEP employs a modified version of the "hands-on" approach and curriculum developed by the University of the District of Columbia's highly successful Saturday Academy Program.

HSSEP began as a program to provide math, science, computer science and communications enrichment for minority high school juniors and seniors who reside in Montgomery or Lowndes County (AL). HSSEP's proposal called for the Program to serve 40-50 students with high academic potential and an interest in mathematics and science in each of its three sessions (i.e., a seven-week Summer Science Training Camp and two 10-week academic-year Saturday Academies).

At the time of its request for 1996-'97 funding, HSSEP submitted an initial evaluation report which indicated that HSSEP was being fully and effectively implemented. The January 1996 Report also presented analyses of interim measures (e.g., math/science course enrollment patterns, Program attendance/persistence rates, participants' reports of increased interest in math/science) which suggested that HSSEP was making progress in its efforts to increase the number of (Montgomery and Lowndes County) minority students interested in and prepared to succeed in college math, science and computer science majors.

The purpose of this follow-up evaluation report is four-fold:

- (1) to determine whether HSSEP has been able to replicate and improve upon its initial implementation success;
- (2) to determine whether closer collaboration with local school districts improved participants' classroom performance in math/science;
- (3) to determine whether there are any systematic outcome differences for HSSEP students with diverse demographic characteristics, educational backgrounds or Program participation patterns; and
- (4) to determine whether the grantee has taken any steps to increase the program's (positive) impact and provide resources for continuing operations once NASA funding is discontinued.

PROGRAM DESCRIPTION

HSSEP has five curriculum components. They are:

Mathematics Applications.-- Students use graphing calculators and a variety of software packages in math and statistics to enhance their understanding of concepts taught in the Integrated Science course and prepare them to improve their performance on standardized aptitude and achievement tests.

Integrated Science.-- Students are introduced to the scientific method and the integration of problem-solving skills in science. Science concepts are explored in biology, chemistry, physics and engineering with an emphasis on the collection, analysis, interpretation and reporting of scientific data. Topics are explored through hands-on laboratory experiments, demonstrations, audio visuals and group projects. The instruction follows the Piagetian learning cycle model of exploration, invention and application.

Computer Literacy and Programming.-- This component provides opportunities for students to learn the basic terminology of computers, procedures for operating a computer correctly, and hands-on activities in BASIC. Students learn to program using BASIC and Turbo PASCAL, and use spreadsheets (e.g., Lotus), data base (e.g., D-Base) and word processing (e.g., Word Perfect) software. By the end of the session, it is expected that students will be able to complete math, communications and science assignments using existing software and computer programs they've written.

Communications.-- This component is designed to enrich reading, writing, comprehension, listening and speaking skills. Communications assignments are designed to strengthen newly acquired skills in the other academic disciplines and students are expected to be able to prepare and present presentations on topics in applied math and science.

Field Experiences in Science.-- Activities include field trips and seminars, career interest inventory completion and analysis; presentations from role models; and career games.

METHODOLOGY

Data produced by the HSSEP information system and evaluation design are derived from:

- content analyses of existing program documents (e.g., the previously submitted evaluation report, attendance/participation records);
- on-site interviews with Trenholm administrators, HSSEP administrators, faculty and students;
- faculty forms for rating students' mastery of course-specific learning objectives and an in-depth Program implementation assessment and self-report outcome survey for students (both developed as part of the new HSSEP information system);
- analyses of students' transcripts;
- tracking data from telephone interviews with HSSEP alumni; and
- Participants' scores on pre-post administrations of parallel forms of the American College Test mathematics and science practice examinations.

Because of their somewhat limited exposure to the Program, the methodology for this study did not examine the post-HSSEP experiences and outcomes of alumni enrolled in collegiate engineering and science majors. As the sample size grows and the HSSEP approach becomes more institutionalized, the alumni assessment will become an integral part of the evaluation process.

Descriptive and comparative analyses of the above-referenced data provide the basis for the findings and discussion presented in the next section.

FINDINGS AND DISCUSSION

RECRUITMENT

Data presented in Table 1 indicate that HSSEP continues to exceed its enrollment goals (40-50 students) -- while operating at a flat (i.e., zero increase) funding level. Table 1's grade-level distribution of participants also reveals that HSSEP's recruitment effort is experiencing increased success in attracting students at an earlier point in the educational pipeline.

Table 2 reveals that HSSEP's 1996-'97 recruiting was expanded to include more students who lack the early college preparatory math exposure that correlates with college success in engineering and science. This slight shift in focus is designed to determine whether HSSEP can ~~increase~~ the pool of well-prepared students through a less selective admissions process, while maintaining the initial success reported in its January 1996 Evaluation Report.

TABLE 1

**The Distribution of HSSEP Students
By Cohort, Gender and Grade Level**

<u>Cohort</u>	<u>New Admits</u>	<u>Gender</u>		<u>Grade Level</u>				<u>2nd Yr. ±</u>	<u>Tot.</u>
		<u>Male</u>	<u>Female</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>		
1994-'95	65	21	44	13	25	8	19	N/A	65
1995-'96	49	8	41	21	20	8	0	25	74
1996-'97	45	12	33	33	12	0	0	32	77

TABLE 2

**The Percentage of New Admits Enrolled in a Math
Course Above, At or Below Grade Level**

<u>Cohort</u>	<u>Above Grade</u>	<u>At Grade</u>	<u>Below Grade</u>
1995-'96	26.5	47.0	26.5
1996-'97	27.2	36.4	36.4

RETENTION, ATTENDANCE AND RE-ENROLLMENT

Attrition in educational enrichment programs beginning at the high school level is a common problem. Student participation declines either because the program has ceased to meet their needs or because other commitments take precedence. In contrast, data suggest that HSSEP's frequent student/parent/staff interactions and its emphasis on rigorous participation requirements, parental involvement in decision-making and continuous implementation improvement have increased student participation (see Tables 3 and 4).

TABLE 3

HSSEP Students' Program Persistence and Attendance Rates

<u>Session</u>	<u># Enrolled</u>	<u># Withdrew</u>	<u># Completed</u>	<u>Retention Rate</u>	<u>Attendance Rate</u>
Summer 94	13	0	13	100%	98%
Fall 94	52	8	44	85%	92%
Winter 95	51	2	49	96%	93%
Winter 96	53	5	48	91%	96%
Summer 96	48	0	48	100%	98%

TABLE 4

Program Persistence Rate by Grade

Cohort	9th Grade Admits	10th Grade Admits
1994-95	38.5	15.4
1995-96	68.4	18.2

The data in Table 4 also support the Program's decision to shift its recruiting focus to ninth graders. Student interviewees report that earlier participation:

- helps them avoid the failure that caused siblings to drop out of the math/science pipeline;

- Unlearn previously learned errors;
- Develop the practice of working in groups; and
- Gain opportunities to earn money as tutors -- while reinforcing skills that they might otherwise have forgotten.

QUALITY OF SERVICES PROVIDED

The newly designed student survey provides insight into specific features and objectives of the HSSEP intervention model. Participant responses (see Table 5) confirm the effectiveness of HSSEP's implementation suggested by preliminary findings cited in the January 1996 Report. At least three-fourths of all respondents strongly agreed or agreed that HSSEP was effectively implemented. The lone exceptions were: linking the communications and technical components (only 42%) and providing adequate time for all students to complete the assignments (62%).

TABLE 5

**Percentage of Students Agreeing or Strongly Agreeing
That HSSEP Intervention was Effectively Implemented**

Orientation clearly spelled out expectations	95
Faculty took the time to answer questions	92
Facilities and classrooms were good	87
Field trips provided good career information	87
Parental activities showed them be more supportive	85
Minority role models provided E&S career insights	85
Staff were available to discuss my concerns	80
Teachers were good	77
HSSEP got all students involved	77
Provided adequate individual attention	75
Teaching assistants were good	74

INDICATIONS OF HSSEP'S POSITIVE IMPACT ON PARTICIPANTS

There are numerous measures by which one can determine the extent to which HSSEP is helping participants achieve the Program's objectives of increased math/science interest and proficiency. Irrespective of whether one examines participant self-reports; faculty ratings; ACT test score data; the math/science grades of students with sustained Program exposure; or the post-high school experiences of HSSEP alumni, a consistent picture emerges. **HSSEP makes a significant, positive difference.**

Participants' Personal Assessments

Students' survey responses reveal their belief that HSSEP is not only effectively implemented, but also plays a major role in increasing their math/science/technology interest and learning. Table 6 indicates that at least 70 percent of all respondents agree or strongly agree with that assessment of all (non-communications) components of the Program.

TABLE 6

**Percentage of Students Agreeing or Strongly Agreeing
That HSSEP Positively Impacted Interest and Learning**

Student Outcome	
HSSEP increased my confidence that I can do well in school	93
I would like to continue participating in HSSEP	89
I learned a lot about science	85
I learned a lot about mathematics	83
I learned a lot about computer programming	75
I became more interested in computer programming	75
I became more interested in science	73
I became more interested in math	70
My writing skills improved	70
My reading skills improved	54
My public speaking skills improved	46

Faculty Assessments of Students' Learning Objectives

Faculty ratings indicate that all of the student learning objectives (except PASCAL programming and software mastery) were accomplished by most or all of the students. Specifically, HSSEP participants succeeded in learning:

- how to operate a computer and program in BASIC;
- how to use computers to solve math/science problems;
- problem-solving skills in science;
- Data collection, analysis, interpretation and reporting;
- how to use graphing calculators;
- how to improve their scores on standardized tests; and
- a wide range of communications skills enhancement techniques.

ACT Test Score Improvement

Beginning in the 1996 summer session, parallel forms of a practice ACT exam were administered on a pre-test post-test basis. Score changes measured how much learned in a preparation course that offered test-taking tips; sample problems; cognitive skill development exercises; insight into the psychometric principles underlying test construction; and other activities with demonstrated effectiveness in raising students' aptitude test scores. With the exception of the ninth grade science section, HSSEP students showed either substantial or statistically significant pre-post improvement (see Table 7).

TABLE 7

Mean ACT Pre and Post-Test Math/Science Scores (By Grade)

<u>Score</u>	<u>Grade</u>			
	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>
Math Pre-Test	11.0	13.9	10.7	11.5
Math Post-Test	14.4*	17.7*	15.4*	15.0
Science Pre-Test	18.7	15.4	17.6	16.0
Science Post-Test	17.2	18.3	20.0	24.8

* = $p < .01$

Future evaluations will examine whether the performance increment achieved during practice sessions will result in higher scores than were achieved by HSSEP with comparable backgrounds who did not have the benefit of having taken the preparation course.

Classroom Performance in Math/Science

The January 1996 Evaluation Report noted that many HSSEP students would be able to take calculus in high school -- because of taking math courses above their grade level in junior high school. While acknowledging the potential benefits of this trend, the Report raised a concern about students' lower-than-expected math/science grades. It was hypothesized that HSSEP students, in their haste to take advanced courses, might not be (1) meeting the performance standards against which they are graded; or (2) mastering concepts critical to their future math/science success.

Secondary analyses of 1994 and 1995 HSSEP cohort GPA data reveal that while low math/science grades may be a problem for students with limited HSSEP exposure, **sustained** Program participation is associated with superior classroom performance. The data in Table 8 illustrate the positive relationship between in-depth HSSEP involvement and math/science grades. They also suggest that as the Program matures and relationships with local districts are strengthened, participants' classroom performance is likely to improve considerably.

TABLE 8

Median Second-Year Math/Science GPA Among Program Persisters

GROUP	GPA
1994 Persisters	2.87
1995 Persisters	3.25
All Persisters	3.00
Non-Persisters	2.50*

* = Persister/Non-Persister difference $p < .05$

Based on the above data, HSSEP should maintain its efforts to keep students in the Program for at least the second year that is required to be defined as a "persister". Since the members of

one Lowndes County family are the County's only "persisters", it appears that HSSEP needs to develop strategies for increasing the (Program) retention of Lowndes students and their rural families so that they can begin to have the same positive outcomes that Montgomery County students are currently experiencing.

1996 Graduates' Post-Program Outcomes

Post-high school outcomes for the 1996 HSSEP class are similar to, but slightly better than the results reported for 1995 graduates. Whereas, 65 percent of the 1995 HSSEP college enrollees were majoring in engineering and science, that figure rose to 78 percent (7/9) for the 1996 graduates. Additionally, the graduation rate was 100 percent and the overall college enrollment rate was 90 percent among HSSEP alumni.

As noted in the January report, HSSEP alumni's post-high school outcomes are in stark contrast to those of their Montgomery County counterparts. Countywide, only 6.5 percent of African-Americans completed special academic programs in science and engineering and only 9 percent planned to pursue careers in engineering, mathematics or science.

EXPANDING AND CONTINUING PROGRAM OPERATIONS

As a first step in the process of increasing services to Lowndes County, a Saturday parents' technology program has been instituted by Trenholm. While it is available to all HSSEP parents, the outreach emphasis has focused on the parents of Lowndes County students. Materials that are used to develop parents' skills in word processing and other computer applications also increase their knowledge about the benefits of technology careers and how parents can facilitate their children's preparation for those careers.

Trenholm has also sought to use on-line technology as part of both its program expansion and continuation (e.g., providing math/science professional development for Lowndes County teachers, accessing Federal agencies' Web sites and the Catalog of Federal Domestic Assistance for grant announcements) efforts. Unfortunately, recent changes in the Stevenson-Wydler Act (per Executive Order 12999) appear to have prioritized K-12 schools -- as opposed to HBCUs -- as target recipients of surplus equipment. Given Trenholm's size and resource limitations, technical assistance in resolving this and other issues would be a welcome addition.

Additional steps in an effort to obtain continuation funding are being pursued through information obtained from the Foundation Center of Washington, DC.

RECOMMENDATIONS

Based on findings and discussion presented earlier in this document, the Evaluator suggests that HSSEP:

- (1) **Make improving the outcomes of rural students a priority** and ensure that there is continuous monitoring and evaluation to determine whether other participant groups may also require special interventions, in order to fully benefit from HSSEP;
- (2) **Actively seek NASA technical assistance in addressing the Program's technology equipment and institutional development needs;**
- (3) **Use emerging technology to expand Program impact and identify sources of continuation funding, as well as supplement existing intervention strategies.** As noted in the January 1996 Report, HSSEP may wish to consider adding Internet assignments as a career exploration tool, a resource in its SAT preparation process, and a proactive approach to retaining students in their junior and senior years.
- (4) **Provide adequate resources for future evaluations to address emerging issues and enable Trenholm to disseminate information about HSSEP's success with non-traditional (e.g., rural, marginally prepared) populations; and**
- (6) **Take steps to improve the integration of technical and communications content and learning objectives.**